

PATENT SPECIFICATION

(11) 1 405 079

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- (21) Application No. 18772/73 (22) Filed 18 April 1973
 (31) Convention Application No. 5150/72
 (32) Filed 20 April 1972 in
 (33) Sweden (SW)
 (44) Complete Specification published 3 Sept. 1975
 (51) INT CL³ D01G 9/08
 (52) Index at acceptance
 D1N 1B11.1B1
 D1F X



(54) A PROCESS AND AN APPARATUS FOR DEFIBRATING FIBROUS BULK MATERIAL

(71) We, KOCKUMS MEKANISKA VERKSTADS AB of Fack, S-201 10 Malmö 1, Sweden, a company duly organized and existing under the laws of Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 The present invention relates to a process and an apparatus for defibrating fibrous bulk material.

15 Among the methods which are at present in use for defibrating loose bulk material having a fibrous structure, such as cellulose, asbestos and the like, mechanical vibration, brushing and blowing with pressurized air may be mentioned as examples. These methods may be used in order to handle relatively short fibred goods which are not tacky. For other kinds of fibrous material other processes must as a rule be resorted to where cutting or otherwise separating tools are used, very often in connection with an addition of chemicals or water.

25 In order to defibrate bulk material of very low density where the material is dry or relatively dry, e.g. cellulose of the qualities used for making paper according to the "dry" method mechanical vibration is however not very efficient. Only at high frequencies of vibration there will be obtained a relatively efficient separation of the fibres. The difficulty is in that case above all to impart vibrations to the bulk material without exposing the support to injurious stresses at the acceleration forces which correspond to a high vibration frequency.

30 A method which may be used to advantage for high frequency vibration is to expose the bulk material to air borne pressure waves. If air or another gas under pressure is simultaneously blown in a suitable manner through the material, a certain loosening and defibrating effect may be obtained. However, the vibration amplitudes will be

relatively insignificant which entails that only minor agglomerations of fibres will be effectively comminuted, whereas the larger ones will essentially remain intact.

According to the present invention the drawbacks mentioned above in a process and an apparatus for defibrating bulk material by means of high frequency vibration in the nature of air borne pressure waves are avoided and there is brought about sufficiently high movement and pressure amplitudes and consequent acceleration forces in order to obtain an effective defibration also of materials of low density which are apt to form flocks.

In order to achieve this purpose the invention provides a process for defibrating fibrous bulk material, wherein the bulk material is exposed to influence from air borne pressure waves in at least two simultaneously acting pressure wave fields of different frequencies.

The invention also provides an apparatus for defibrating fibrous bulk material by exposing the bulk goods to influence from air borne pressure waves in at least two simultaneously acting pressure wave fields of different frequencies, wherein there is provided a support for carrying the fibrous bulk material, and at least two pressure wave generators of different frequencies, located adjacent the support for generating pressure waves interfering with each other and influencing the bulk material carried on the support.

An example of the invention will be described in the following with reference to the accompanying drawing, in which

Fig. 1 is a diagrammatic view of an apparatus for putting the process according to the invention into effect, and

Fig. 2 illustrates a modification of the embodiment according to Fig. 1.

In the process according to the invention the bulk material to be defibrated are exposed to the action of the air borne pressure

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waves in at least two simultaneously acting pressure wave fields of different frequencies. On account of the frequency difference between the pressure waves in the pressure wave field an interference pressure wave is obtained having a frequency which is equal to the difference between the pressure wave frequencies in the simultaneously acting pressure wave fields. When the pressure waves are momentarily in phase, combined impulses will be obtained in the interference wave which have such a high energy content that a defibrating effect is achieved in spite of relatively small intensities in the individual sound fields. The energy contents of each pressure wave in the interference wave will thus be sufficiently high to bring also relatively large agglomerations into oscillation with an amplitude required for defibration. The other vibration effects which occur, partly as a consequence of the direct radiation from each one of the pressure wave generators used for generating the pressure waves, partly as a consequence of the physical pressure wave addition, is utilized to tear loose fibres in the surface layers of the flocks appearing in an intermediate stage of the course of defibration.

Different kinds of pressure wave generators occurring on the market may be used in order to put the process according to the invention into effect but in experiments on which this invention is based pneumatically operated sound transmitters of the diaphragm valve siren type have been used and have proved to yield highly satisfactory defibration results. A specific advantage in using pneumatically operated sound transmitters of the said kind as pressure wave generators is that these will generate not only pressure waves but also a pulsating gas stream which may be utilized for loosening the bulk material and also contributes to the further transport of the defibrated bulk material.

In the embodiment according to Fig. 1 both throughflowing gas, generally air, and pressure waves in the gas are used in order to bring about a loosening and defibration. In the device diagrammatically shown in the figure the lower container 1 is the frame of an upper container 2 which has a bottom 3 in the nature of a gas permeable screen of metal wire netting or the like. On the bottom there rests a layer of the material 4 to be defibrated. A sound transmitter 5 is disposed beneath the bottom and a corresponding sound transmitter 6 is disposed in the upper container 2 above the bulk material. If, as in the device disclosed in the drawing, the sound transmitters are operated with air, the air which flows out in the nature of pressure waves through the opening of the horn will be pressed further upwards through the bottom and the bed.

The fibres torn loose are carried with the air through the outlet 7 to a storage chamber or directly to a processing machine. Through an entry opening 8 new bulk material is supplied continuously.

In the process according to the embodiment described it is easy to prevent the undesired effect which may appear when using so called floating beds, when small agglomerates are bouncing up and down in relation to the support and will consequently give a granulating effect. As a matter of fact, both the carrying air current through the bed and the vibration effect from the lower and the upper sound transmitters are controlled here. Experiments have shown that this controlling or balancing possibility may be of use for the best defibration.

Another possibility which may easily be utilized in the embodiment described is to supply moisture from below through the bed or alternatively from above in the nature of either steam or finely distributed droplets in the driving gas through the sound transmitters or in the nature of aerosoles through special spray nozzles. With regard to the continued handling of the fibres it is as a matter of fact often desirable that they are slightly moistened, for instance in order to make it possible to orient their direction in an electrostatic field.

When utilizing the present process on an industrial scale the gas permeable bottom may be made as an endless belt, as a rotating disk or the like, in order to permit a completely continuous operation. Furthermore, sound insulation of the two containers is as a rule required since the practically usable frequencies lay within the audible range, preferably 100 to 1000 Hz.

If the fibrous bulk material is moistened and has a great tendency to flockulate it may be advantageous to expose the bulk for a short time to a shock-like high intensity oscillation field, whereby a particularly high defibrating effect is obtained. This may for instance be achieved by exposing the bulk material to the acoustic oscillation field which occurs in the immediate vicinity of the sound transmitter.

For a normal defibration, however, the powerful movements which arise in this kind of high effect influence will be so great that in the air-fibre mixture which flows out it is possible to obtain undesirable flockulations which have not had time to disintegrate completely. Therefore, a periodical use of the strong sound field is preferred, in which connection there is provided simultaneous shutting off automatically in the container outlet.

In the apparatus shown diagrammatically in Fig. 2 the above mentioned shock defibration is applied. The apparatus shown in

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the figure differs from the apparatus according to Fig. 1 above all in that the upper sound transmitter 6 is movably mounted in order to permit periodical movement between an upper position and a position in the immediate vicinity of the material 4. The periodical movement — diagrammatically shown in the figure as a displacing movement — is achieved by means of operating members 9, for instance a pneumatic cylinder piston unit which is connected with the sound transmitter 6 and which is caused to perform a periodical displacement of the sound transmitter towards and away from the bulk material 4 under the action of the change of the air pressure supplied between piston side and plunger side which is brought about by means of the switching valve 10. Through a suitable device, for instance of a mechanical kind, the movement of the sound transmitter 6 may be connected to a shut off valve 11 in the outlet 7 of the container 2 so that the outlet is kept closed during the time when the strong sound field of the sound transmitter influences the bulk material. Alternatively, an additional sound transmitter may be stationarily disposed with the horn opening near the bed in order to be operated periodically in accordance with what has been said before. An additional possibility is to let the upper sound transmitter 6 operate intermittently at an essentially higher intensity than normal, in which connection valve 11 is simultaneously, preferably in an automatic manner, caused to occupy the closing position.

If the bottom is made as an endless conveyor a plurality of sound transmitter pairs may be disposed at a certain relative distance along the conveyor, in which case the bulk goods is caused to pass successively through several pressure wave fields. The shock defibrating described above may in that case be brought about by some of the sound transmitters being arranged for high intensity influencing of the bulk material according to one of the manners previously described.

The invention is not restricted to the embodiments described above but may be varied within the scope of the appended claims. Thus, the bulk material may for instance be conveyed in a tubular passage to which the pressurized air streams pulsating through the air transmitters are supplied at a great velocity.

WHAT WE CLAIM IS:—

1. A process for defibrating fibrous bulk material, wherein the bulk material is exposed to influence from air borne pressure waves in at least two simultaneously acting pressure wave fields of different frequencies.

2. A process as claimed in claim 1, where-

in the bulk material is exposed to action by pressure wave fields of different intensity.

3. A process as claimed in claims 1 and 2, wherein the bulk material being transported in a path is caused to pass through pressure wave fields of different intensity.

4. A process as claimed in claim 1 or 2, wherein at least one of the pressure wave fields is caused to influence the bulk material at a periodically variable intensity.

5. A process as claimed in claim 4, wherein the intensity variations are brought about by a pressure wave generator during the generation of the pressure wave having a periodical movement imparted to it towards and away from the bulk material.

6. A process as claimed in claim 4, wherein the intensity variations are achieved by the power supplied to a pressure wave generator, being caused to vary periodically.

7. A process as claimed in claim 4, wherein the intensity variations are brought about by periodically connecting a pressure wave generator located at a smaller distance from the bulk material than other pressure wave generators.

8. A process as claimed in any one of claims 1 to 7 in which the bulk material is carried by an air and sound permeable bed, wherein a pressure wave field directed towards the bulk material is generated below and one above the air and sound permeable bed.

9. A process as claimed in any one of the preceding claims, wherein the pressure wave fields are generated by simultaneous supply of driving gas to at least two pneumatically operated diaphragm valve sirens having different frequencies within the audible range.

10. An apparatus for defibrating fibrous bulk goods by exposing the bulk material to influence from air borne pressure waves in at least two simultaneously acting pressure wave fields of different frequencies, wherein there is provided a support for carrying the fibrous bulk material, and at least two pressure wave generators of different frequencies, located adjacent the support for generating pressure waves interfering with each other and influencing the bulk material carried on the support.

11. An apparatus according to claim 10, wherein at least one of the pressure wave generators is periodically movable towards and away from the support.

12. An apparatus according to claim 10, having at least three pressure wave generators provided adjacent the support, of which one is mounted more closely to the support than the others and in the immediate vicinity of the support and provided with means arranged to connect the said one pressure wave generator periodically for intermittent pressure wave generation.

13. An apparatus according to any one of claims 10 to 12, wherein the support forms an air and sound permeable bed and wherein at least one pressure wave generator is arranged above and one below the bed.
14. An apparatus according to any one of claims 10 to 13, wherein the support consists of a conveyor for conveying the bulk material through pressure wave fields generated by the pressure wave generators.
15. An apparatus according to any one of claims 10 to 14, wherein the pressure wave generators consist of pneumatically operated diaphragm valve sirens having frequencies within the audible range.
16. A method for defibrating fibrous bulk material substantially as herein described.
17. An apparatus for defibrating fibrous bulk material substantially as herein described with reference to Fig. 1 in the drawing.
18. An apparatus for defibrating fibrous bulk material substantially as herein described with reference to Fig. 2 in the drawing.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1975.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

Fig 1

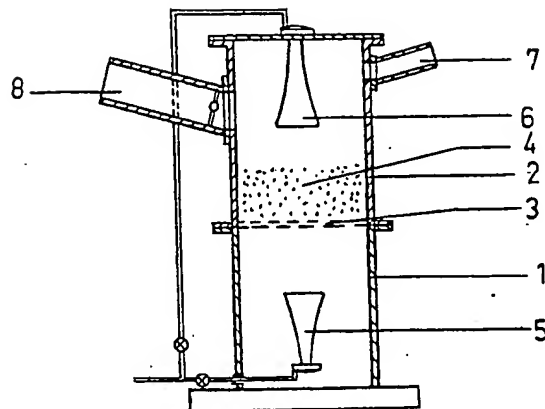


Fig 2

